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Glen Roy, ice-work in Great Britain and Ireland, and in Europe and other parts of the world constitute the leading themes ; and Part III, relating to theoretical questions, especially the temperature of the glacial epoch, its possible causes, and the number of epochs. The discussion of the temperature of the glacial epoch embraces the largest amount of measurably unfamiliar material and is perhaps to be regarded as the most valuable part of the book. The description of alpine and polar glaciers is not brought up to date and is sadly lacking in suitable illustrations, for which abundant material now exists. In the discussion of the traces of the glacial epoch disproportionate attention is given to the excavation of lake basins, to the exclusion of erosive work in other lines quite as important, and the author's impartiality is not as well sustained here as elsewhere. Very much attention is given to the glacial phenomena of Great Britain, and relatively scant attention to that of Europe and America. It is natural that an English writer, presumably having in mind chiefly the English public, should give much prominence to home phenomena, but obviously in a work which takes on so comprehensive a title and is published as a part of an international series, the distribution of attention should be somewhat proportional to the development of the phenomena. In the discussion of the possible causes of the glacial epoch the author's judicial attitude appears to the best advantage. We think he is correct in concluding that "the glacial epoch has not yet received any satisfactory explanation." The literary style of the work is excellent, the language being clear and quite free from rhetorical coloration. The illustrations are not only scant and poor, but the selection is unfortunate in several cases, some of them being unworthy of reproduction.

T. C. C.

General Relations of the Granitic Rocks in the Middle Atlantic Piedmont Plateau, by G. H. WILLIAMS. (Fifteenth Annual Report, U. S. Geol. Surv., pp. 657-684.)

THE Piedmont plateau is classic ground in American geology. Within its limits many of the important problems of American science have been worked out, but by far the larger number of questions which it presents are yet unanswered. It is a region of great complexity. From the holocrystalline, undoubted igneous masses of the eastern border to the unchanged sedimentaries further west there is

every gradation. Dynamic metamorphism, contact phenomena, folds, faults, thrusts, shearing, and foliation are all presented over and over again. The unraveling of the history of such a region must be the result of long and patient detailed work. Only after most elaborate field and laboratory investigations can facts of broad bearing be enunciated.

It was in this region that the late Professor Williams did by far the larger portion of his life's work, and he had a knowledge of it which no other man has ever had. The results of many of his studies have been already published, and so we have his papers on the gabbros and his beautiful map of the Baltimore region. The larger generalizations which only come after many years of study were in many cases not yet completely formulated, and in others, while formulated, were unpublished.

In the present paper we have Professor Williams' views as to the origin of the granites and pegmatites. As an introduction to the former he has summarized the criteria for the recognition of ancient plutonic rocks in highly metamorphosed terraines; a summary which is most valuable, though marred by the incompleteness of the references. Among other field evidences of the igneous origin of doubtful rock masses are enumerated the presence of radiating apophyses, foreign inclusions, and contact zones. That these may be obscured is recognized, and in the recognition of altered eruptives the author evidently relies largely upon chemical and petrographical evidence. The test formulated by Rosenbusch and depending upon the definite or indefinite character of the chemical composition of the rock has been applied by Professor Williams to certain of the gneisses of the region. Faint traces of structure originally igneous are found in rocks which are quite completely changed. The development of certain minerals is regarded as strongly suggestive of contact metamorphism. The determination of the relative ages of intrusions in such a region must rest largely upon contact phenomena. Often an eruption may prove to be anterior or posterior to some period of strong metamorphism, and hence its relative place in the history of the region may be known. It is by means of such evidence that the origin of the granite masses has been tested. The detailed observations upon granites of the central portion of the state are recorded by Dr. Keyes, and in general it may be stated that with few exceptions the granites of the entire region may be proved to be of igneous

origin. A very interesting table showing the chemical composition of the ancient igneous rocks of Maryland accompanies this paper.

With regard to the pegmatites, evidence is presented for the belief that very many of them are eruptive; though it is not thought that all will be found to have had that origin. The evidence that they are eruptive is based upon the agreement in composition between the granites and the pegmatites, the greater abundance of the latter near granite masses, their independence as regards the character of the rocks they cross, their relations to the adjoining rock, and the fact that as a rule these pegmatites are neither drusy nor symmetrically banded. The fact that in spite of the essential identity between the composition of the pegmatites and the granites there are certain differences, is interpreted as pointing to somewhat different conditions of formation, in which there was a greater activity of the mineralizing agencies.

The author agreed closely with De Beaumont, Lehmann, and Brögger in his conception of the process of the origin of these pegmatites. They are interpreted "as the products of the residual, and therefore most acid, portion of a granite magma highly charged with water and other mineralizing agents, in a state intermediate between fusion and solution, interjected into fissures and there crystallized in very coarse-grained aggregates, not necessarily through any great slowness of this process, but rather in virtue of the aid to crystallization afforded by the abundance of mineralizers present."

H. F. BAIN.

Sketch of the Geology of the San Francisco Peninsula, by ANDREW C. LAWSON. Fifteenth Ann. Rep. U. S. Geol. Surv., pp. 399-476. Pls. V-XII.

THIS paper is a valuable contribution to the literature of the Pacific coast. The area considered lies between the Pacific Ocean and San Francisco Bay, and extends from the Golden Gate southward about twenty-one miles.

The work done reveals seven formations which, in their geological order, are: (1) Crystalline limestone; (2) Montara granite; (3) The Franciscan series; (4) Sandstone of Tejon (?) age; (5) The Monterey series; (6) The Merced series; (7) The Terrace formations.

The Montara granite is exposed along the Pacific shore about one